CERTIFICATE *OF* COMPLETION

This is to certify that

NRI INSTITUTE OF TECHNOLOGY

has successfully completed

CARBON FOOTPRINT & ENERGY AUDIT

The study was completed by Rekhapalli Environmental Solutions & Technologies Pvt Ltd

Dr Rekhapalli Srinivasa Rao

Green, Eco & Energy Lead Auditor
Certified ISO-14001 Auditor

Issued by

Rekhapalli Environmental Solutions & Technologies Pvt Ltd

August 2022

NRI INSTITUTE OF TECHNOLOGY

Pothavarappadu (V), Agiripalli (M), Eluru District, A.P., India-521212

Carbon Footprint and Energy Audit

CONTENTS

Acknowledgements

REST Pvt Ltd

Dr Rekhapalli Srinivasa Rao
Green, Eco & Energy Lead Auditor
Certified ISO-14001 Auditor

22 August 2022

Carbon Footprint & Energy Audit

The REST Pvt Ltd acknowledges with thanks the cooperation extended to our team for completing the study at NRI Institute of Technology (NRIIT).

The interactions and deliberations with NRIIT team were exemplary and the whole exercise was thoroughly a rewarding experience for us. We deeply appreciate the interest, enthusiasm, and commitment of NRIIT team towards environmental sustainability.

We are sure that the recommendations presented in this report will be implemented and the NRIIT team will be further improve their environmental performance.

Kind regards

Your sincerely

Dr Rekhapalli Srinivasa Rao

Green, Eco & Energy Lead Auditor
Certified ISO-14001 Auditor
REST Pvt Ltd

Executive Summary

The growth of countries across the world is leading to increased consumption of natural resources. There is an urgent need to establish environmental sustainability in every activity we do. In a modern economy, environmental sustainability will play a critical role in the very existence of an organization.

An educational institution is no different. Built environment, especially an educational institution, has a considerable footprint on the environment. Impact on the environment due to energy consumption, water usage and waste generation in an educational institute is prominent. Therefore, there is an imminent need to reduce the overall environmental footprint of the institution.

As an Institution of higher learning, NRI Institute of Technology (NRIIT) firmly believes that there is an urgent need to address the environmental challenges and improve their environmental footprint.

True to its belief, NRIIT has installed good quantity of solar power panels capacity of 200kWA. REST Pvt Ltd team congratulates NRIIT team for their efforts.

Keeping NRIIT work in energy efficiency, we recommend the following to be taken by the competent team at NRIIT:

Work towards achieving carbon neutrality: NDC emphasizes creating an additional carbon sink of 2.5 to 3 billion tonnes of CO^2 equivalent through additional forest and tree cover by 2030. NRIIT's net carbon emission for the year 2021-22 is >200 MT CO^2e. NRIIT should focus on energy efficiency, renewable energy, and carbon sequestration as tools that will enable them to offset the present carbon emissions and achieve carbon neutrality.

Installation of solar rooftop: Renewable energy plays a very important role in improving the environmental footprint of an organization. By increasing the share of renewable energy in NRIIT's energy portfolio, the overall carbon footprint of the college can be reduced. The roof/ campus area available at NRIIT is around **2,72,429.83** sq.ft. For the available area, occupied with 200 kWp of solar PV Installed. As an initial step, NRIIT could look at installing another 50kWp of solar PV which can generate 80,100 units per year. Still the renewable share will also reduce the 25 MT CO^2e. For the current assessment year power consumption is **5,02,140** units/year. Still some more area of roof top can be utilized for solar power to expand.

Increase the operating power factor: Presently, based on the energy bills, it is understood that the institution maintains a power factor of 0.65. Since the institution pays electricity bills for the KVAH consumed, the lower the power factor, higher is the energy bill for the same KWH consumption. It is recommended to install capacitor banks to improve the power factor and save energy bill. NRIIT can save up to Rs. 20,000 per month.

Improve energy efficiency of the college: It is recommended to adopt latest energy efficient technologies for reducing energy consumption in fans, lighting, and air conditioners. We recommend the following projects to be implemented at the earliest:

- Replace conventional 60W ceiling fans with energy efficient BLDC fans of 30W
- Install air conditioners energy savers to save energy in split air conditioners
- Replace all conventional tube lights with LED lamps

Carbon Footprint and Energy Audit

NRI Institute of Technology (NRIIT) and REST Pvt Ltd are working together to identify opportunities for improvement in energy efficiency and carbon reduction. This report highlights all the potential proposals for improvement through the audit and analysis of the data provided by NRIIT for lighting, air conditioning, ceiling fans, and biogas potential.

The report also details the carbon emissions from college operations. For carbon emissions, scope 1 and scope 2 emissions are calculated from the data submitted by NRIIT. The report emphasizes the GHG emission reduction potential possible through a reduction in power consumption.

Effect of pandemic and online classes on energy consumption and carbon footprint:

The year 2020-21 was affected by the pandemic and because of the pandemic, most of the classes were shifted online. There has been a steady in the consumption of energy in the year2021-22. NRIIT's carbon footprint for the year 2021-22 will be smaller compared to the previous year.

Submission of Documents

"Carbon footprint and energy audit at NRIIT was carried out with the help of data submitted by NRIIT team. NRIIT team was responsible for collecting all the necessary data and submitting the relevant documents to REST Pvt Ltd for the study.

Note

Carbon footprint and energy audit are based on the data provided by NRIIT team and discussions the REST Pvt Ltd team had with NRIIT team. The scope of the study does not include the exclusive verification of various regulatory requirements related to environmental sustainability.

REST Pvt Ltd has the right to recall the study if it finds (a) major violation in meeting the environmental regulatory requirements by the location and (b) occurrence of major accidents, leading to significant damage to ecology and environment.

Opportunities for improvement

As a part of the overall environmental improvement study at NRIIT, carbon footprint calculations were also carried out. The objective of calculating the carbon footprint of the campus is find the present level of emissions from campus operation and what initiatives that the NRIIT can take to offset the emissions. By offsetting the emissions, the college can become carbon neutral in the future by adopting energy efficient processes, increase in renewable energy share and tree plantation.

Carbon footprint calculations:

To help delineate direct and indirect emission sources, improve transparency, and provide utility for different types of organizations and different types of climate policies and business goals, three "scopes" (scope 1, scope 2, and scope 3) are defined for GHG accounting and reporting purposes.

For calculating carbon footprint of the campus, Scope 1 & Scope 2 emissions are being considered. Since day scholars use college provided transportation and hostelers stay in campus, Scope 1 and Scope 2 are the highest contributor to overall emissions. For this reason, Scope 3 is not being calculated.

Scope 1: Direct GHG Emissions

Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled DG sets, canteen, vehicles, etc.; emissions from chemical production in owned or controlled process equipment. Direct CO2 emissions from the combustion of biomass shall not be included in scope 1 but reported separately.

NRIIT Scope 1 emissions for 2021-22:

Sources of Scope 1 emissions in NRIIT:

1) Diesel used for college-owned transportation: 1,20,000 lts/year

2) Diesel consumption for the generator for the assessment year 2021-22 is minimum (included in above consumption).

3) LPG used for canteen: 600 cylinders/year

Scope 2: Electricity Indirect GHG Emissions

Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by a company. Purchased electricity is defined as electricity that is purchased or otherwise brought into

the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

NRIIT Scope 2 emissions for 2021-22: Electricity purchased from grid: **5,02,140** Units

Develop a roadmap to increase contribution of renewable energy in the overall energy consumption

To have a continued focus on increasing renewable energy utilization to 100% which will also lead to reduction in GHG emissions, it is suggested to develop a detailed roadmap on RE utilization. The road map should broadly feature the following aspects -

- Renewable energy potential of NRIIT and the maximum offset that can be achieved at NRIIT
- Percentage substitution with renewable energy that NRIIT wants to achieve in a specified time frame

Key tasks that need to be executed to achieve the renewable energy target

- Specific financial break up for each of the projects highlighting the amount required, available and the utilization status as on date
- A regular review mechanism to ensure progress along the lines of the roadmap should be framed
- The roadmap should also highlight important milestones/key tasks, anticipated bottle NRIIT & proposed

Renewable energy roadmap should be used as a base to frame GHG emissions reduction target

It is suggested to use the developed renewable energy roadmap to correlate the GHG reduction that each of the renewable energy project will achieve. This approach will provide a base to set targets for reduction in GHG emissions. The action plan for renewable energy will shoulder the action plan for GHG emissions reduction and work towards achieving carbon neutrality.

Explore the option of other onsite and offsite renewable energy projects

The renewable energy field has been witnessing many private investors due its increased market demand and attractive policies in many states. There are Renewable Energy Independent Power Producers (RE IPPs) who have installed RE based power plants like wind, small hydro and solar PV. GOC can consider having a long-term power purchase agreement with these RE IPPs in purchasing fixed quantity of power for a period of 5 to 10 years.

"Evolve a system to monitor the implementation of various GHG mitigation opportunities NRIIT has an action plan to reduce its GHG emissions. NRIIT should also evolve a system to monitor the implementation of various GHG mitigation opportunities. It is recommended to use a Gantt chart to mark out the action plan for the activities and track its implementation. Gantt chart will serve as an excellent way to instantly monitor and comprehend all different tasks in one place which would ease tracking of implementation.

Calculation for Installation of 25 kWp of Solar PV in NRIIT campus

Renewable energy is one of the important steps to be taken up by the college to reduce their overall carbon footprint. Based on the details provided by NRIIT team, The roof/ campus area available at NRIIT is around **2,72,429.83** sq.ft. For the available area, occupied with 200 kWp of solar PV Installed. As an initial step, NRIIT could look at installing another 50kWp of solar PV which can generate 80,100 units per year. Still the renewable share will also reduce the 25 MT CO^2e. For the current assessment year power consumption is **5,02,140** units/year. Still some more area of roof top can be utilized for solar power to expand the roof top solar PV capacity. However, for this report calculation, only 25 kWp capacity is considered.

A renewable energy capacity of 25 kW of solar panel may be installed can generate 40,500 units of electricity per year. Additionally, 25 kWp of solar rooftop can offset 33 MT CO2e per annum. RESCO model for solar rooftop installation:

A Renewable Energy Service Company (RESCO) is an ESCO Energy service company which provides energy to the consumers from renewable energy sources. RESCO or BOOT model is about pay as Ju consume the electricity.

- Solar Power Plant is owned by the RESCO or Energy Company
- Customer must sign a Power purchase Agreement (PPA) with actual investor at mutually agreed tariff and tenure
- Customer only pays for electricity consumed
- RESCO developer is responsible for its annual operations & maintenance (O&M)
- The RESCO gets the benefit by selling the surplus power generated to the DISCOM

Source: www.bluebirdsolar.com

Energy Efficiency

Annual energy consumption of NRIIT campus is **5,02,140** units. There are major blocks in the campus which consumes energy for their operation. Major energy consumers are:

1. Fans

2. Air conditioners

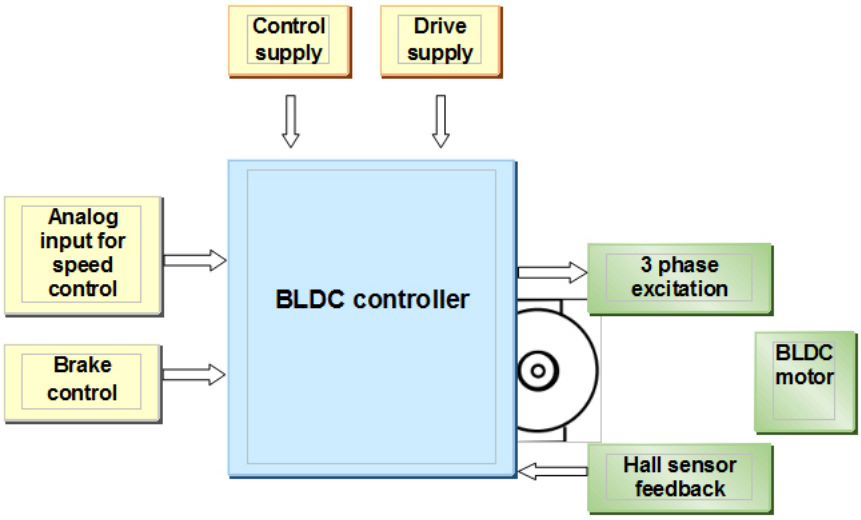
Replace conventional tube lights with LED lamps

Replace Conventional Ceiling Fans with Energy Efficient BLDC Fans

During the Energy Audit at NRIIT, a detailed study was carried out to identify the potential for replacing the existing ceiling fans with BLDC super fans. There is 72 kW power consumption by fans operating in NRIIT campus.

Instead of conventional ceiling fans, latest technology BLDC fans which consume only 30W can be installed in the newly constructed building. A brushless DC (BLDC) motor is a synchronous electric motor powered by direct-current (DC) electricity and having an electronic commutation system, rather than a mechanical commutator and brushes. A BLDC motor has an external armature called the stator, and an internal armature called the rotor.

The rotor can usually be a permanent magnet. Typical BLDC motor-based ceiling fan has much Letter efficiency and excellent constant RPM control as it operates out of fixed DC voltage. The proposed BLDC motor and the control electronics operate out of 24V DC through an SMPS having input AC which can vary from 90V to 270V. The operational block diagram of a BLDC motor is as follows:



With the replacement of existing ceiling fans with Super Fans the energy consumption is likely to reduce by 55% per fixture. Considering 100 fans being replaced with super-efficient BLDC fans, 3.50 kW can be saved. Considering the average operating hours to be 2000 and unit cost as Rs.9, the calculations are as follows:

Total power consumption by fans in college	:	72kW
No. of fans considered for calculation	:	100 (First cycle of change)
Energy consumption per fan	:	80 W
Total energy consumption of fans	:	80W X 100 fans
	:	8 kW
super-efficient BLDC fans energy consumption:		30 W
Savings from 80W to 30 W	:	55%
Total savings in fans energy consumption	:	55% of 8kW
	:	4.4 kW
Savings per year	:	4.4 kW x 2000 hrs X Rs. 9/unit
	:	Rs. 0.79Lakhs
Investment	:	Rs. 2, 50,000
	:	37 months

Annual emission reduction potential in case of replacing 25% fans : 20MT CO_2

Install Air conditioners energy saver for spilt air conditioners:

Present status: As per the data obtained from NRIIT team, the campus has majorly 260 Ton of Refrigeration units installed.

Recommendation:

We recommend installing "Airtron", an energy saver that can be installed at every individual unit of AC. The Airtron is the world's most advanced AC SAVER, with all the controls of a Precision AC. The Airtron's dual sensors reference the Room and Coil & Ambient Temp, and uses complex, multiple algorithms in a "closed-loop circuit" to reduce the Compressor Run-Time, to ensure the high savings while maintaining and displaying the Set temperature accurately. The Airtron is Programmable for geographical location and climate and adapts automatically to changes in season and ambient conditions.

This unique device has been developed on Patent-Published technology and approved by leading MNC'S, PSU'S and Govt. Departments. The Airtron is validated by EESL (Energy Efficiency Services Ltd.), Ministry of Power, Government of India, for 44% savings. The Airtron has been validated on all AC's- Inverters, 5 Star, Splits, Multi-Splits, Packages, ducts, Windows, Cassettes from 1.0 - 20.0 TR, LG ltd, Videocon Ltd, Tata Communications, L&T, Nestle, Ashok Leyland etc. The AIRTRON comes with a Remote for setting the Room Temperature, and in a Non-Flammable Polycarbonate Enclosure, with SMPS Power Supply, to tolerate w ide Voltage and Current fluctuations, Surges, Spikes and Sags.

In our case, Airtron installation can reduce the energy consumption of each fixture by 15% on a conservative basis. For a total energy consumption, for air conditioners, as 20 units per hour, 3 units per hour can be saved. It is recommended to install Airtron energy saver in a phase wise manner preferably in the batches of 10 units.

Saving Calculation: Considering the operating hours to be 2000 and unit cost as Rs 9.0/-.

- Monetary annual savings : Rs 55,000/-
- Total investment : Rs 80,000/-
- Payback period : 18 months (1.5 years)
- Annual emission reduction potential: 4.92 MT CO2

Replace Conventional Lamps with LED Lamps

As per the data submitted, the total number of all the lighting bulbs & fixtures installed are

1. Normal tube fixtures : 62.64 kW
2. LED tube fixtures : 8.8kW
3. Normal bulbs : 12.4 kW
4. LED bulbs : 8.28kW

Under failure replacement policy, at least 130 lamps can be changed in the first year.

Types of fixtures	36W Tube
No of fixtures	130
No of hours in Operation	2000

The campus should be keen in harnessing the day lighting available thereby reducing the use of artificial lighting.

Based on the occupancy, monitoring should be ensured to reduce excessive consumption of energy.

Major savings in energy through lighting fixtures can be achieved by replacing all the above existing fixtures with LED's meeting the required LUX levels. The LED's being less energy consuming while maintaining the equivalent lux is the more sustainable option. The replacement of lighting fixtures should be done as per failure replacement policy i.e. change the old fixture with LED when it fails

Advantages of LED

- Lower energy consumption: The energy consumption of LEDs is low when compared to the other conventional sources for the same amount of Lumen output.

Performance comparison of different type lights

Type of Lamp	Lumen/Watt	CRI	Life hours
HPSV lamps	90-120	Bad (22-25)	15,000-20,000
Metal Halide lamps	65-100	Good (65-90)	18,000
LED lamps	100-150	Very Good (>80)	10,000-12,000

- **High S/P ratio:** LEDs have higher scotopic/photopic ratio (S/P ratio). The eye has two primary light sensing cells called rods and cones - cones function in day light and process visual information whereas rods function in night light. The cone dominated vision is called photopic and the rod dominated vision is called scotopic. The S/P ratio indicates the measure of light that excites rods compared to the light that excites cones. In office environments, illumination is more effective if the S/P ratio is high as it is under scotopic region. LEDs hence are ideally suited for these applications as they have a high S/P ratio.

- **Longer life-time:** LEDs have longer life time of around 1,00,000 hours. This is equivalent to 11years of continuous operation or 22 years of 50% operation.

- **Faster switching:** LED lights reach its brightness instantly upon switching and can frequently be switched on/off without reducing the operational life expectancy.

- **Greater durability and reliability:** As LEDs are solid-state devices and uses semi-conductor material; they are sturdier than conventional sources that use filaments or glass. LEDs can also withstand shock, extreme temperatures and vibration as they don't have fragile materials as components.

- **Good Colour Rendering Index (CRI):** The colour rendering index, i.e., measure of a light sources' ability to show objects as perceived under sunlight is high for LEDs. The CRI of natural sunlight is 100 and LEDs offer CRI of 80 and above.

  LED offers more focused light and reduced glare. Moreover, it does not contain pollutants like mercury. LED technology is highly compatible for solar lighting as low-voltage power supply is enough for LED illumination.

Calculations are as follows:

Existing Lighting fixtures	36W
Existing power consumption(kW)	4.5kW (130lamps)
Proposed LED wattage (W)	15
LED power consumption (kW)	1.95kW
Energy saving (kW)	2.55kW
Opearting hours	2000

Annual monetary savings	:	Rs 38,250/-
Investment needed	:	Rs 90,000/-
Payback period	:	2.5 years
Annual Emission reduction potential	:	4.18MT of CO2.

Conclusion

NRIIT has initiated few energy efficiency activities in their campus. While REST Pvt Ltd appreciates the NRIIT team for their efforts, we would like to emphasize that opportunity exists further reduce the energy consumption. Installation of renewable energy is to be given major focus. RESCO model can be adopted to install renewable energy without upfront capital investment. We in REST Pvt Ltd are sure that all the recommendations mentioned in the report will be implemented by NRIIT team and the overall environmental performance of the campus will be improved.

SUSTAINABLE LIVING INC

Certificate of Completion

This is to certify that

NRI Institute of Technology

has successfully completed

Carbon footprint study and energy audit

The study was completed by Sustainable Living Inc

Hiran Prashanth
Environmental Sustainability Auditor
Sustainable Living

Issued by Sustainable Living Inc

July 2021
GA – 01 – 21 – NRIIT

REPORT ON
ENERGY AUDIT
2021-2022

NRI INSTITUTE OF TECHNOLOGY

(AUTONOMOUS)

Approved by AICTE, New Delhi: Permanently Affiliated to JNTUK, Kakinada

Accredited by NAAC with "A" GRADE, Accredited by NBA (CSE, ECE&EEE)

An ISO 9001:2015 Certified Institution

Pothavarappadu (V), Agiripalli (M), Eluru District, A.P., India, Pin: 521 212

URL: www.nriit.edu.in, email: principal@nriit.edu.in, Mobile: + 91 8333882444

FOR

TABLE OF CONTENTS

PREFACE

Energy conservation methods are one of the most important topics of concern in most countries. Energy auditing is the monitoring and analysis of the use of energy including submission of report containing recommendations for improving energy efficiency and an action plan to reduce energy consumption (The Energy Conservation Act, 2001). It is a study to determine how and where energy is used, and to identify methods for energy savings. It identifies all the energy streams in a system and quantifies the use of energy according to its discrete functions. It facilitates a systematic approach to the energy management in a system, trying to balance the total energy input with its use.

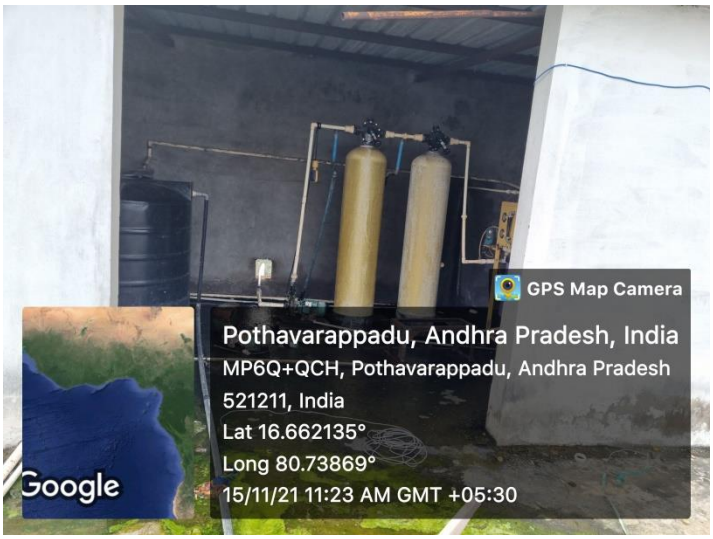
The energy audit of NRI Institute of Technology was carried out by the Department of Electrical and Electronics Engineering department, under the supervision of the Energy Audit team. The energy auditing is an on- going process, a part of a larger procedure to ensure long term sustainable development. Based on the outcome of our analysis of data we have enlisted probable solutions in order to ensure minimizing energy waste and maximizing energy potential in the campus. We hope that the audit will be fruitful in terms of energy conservation.

1. INTRODUCTION AND SITE DESCRIPTION

NRI Institute of Technology, started in 2008 is the result of sincere and dedicated efforts and stern determination of the founders of the Sri Durga Malleswara Educational society. NRI Institute of Technology is an AICTE approved Institution permanently affiliated to the JNTUK which functions as a private self financing institution to cater to the needs of juvenile aspirants in and around Vijayawada.

The promoters of NRIIT started the college with a vision to empower the students with vibrant technology, sensitively matured and innovative to face the challenges of real time global experiences. The founders are socially conscious and continuously responding to the needs and requirements of the region, to uplift the region and to promote educational facilities by establishing schools, to promote games and sports activities in the region, help the poor and improve their health standards by organizing free medical camps etc., Since the day of inception, NRIIT has been growing at a credible but steady pace for an educational institution of its kind.

The main source of energy for the college is the electricity from Andhra Pradesh Central Power Distribution Corporation Limited (APCPDCL). There is also a 105KW solar panel energy harvesting system in the main block-1 and 95 KW solar panel energy harvesting system in the EEE block-2 .




DANGER
GPS Map Camera
Pothavarappadu, Andhra Pradesh, India
MP6Q+QCH, Pothavarappadu, Andhra Pradesh 521211, India
Lat 16.662135°
Long 80.73869°
15/11/21 11:22 AM GMT +05:30
Google

The electricity is mainly utilized for the following purposes

(i) Lighting and operating fans in office, staff rooms, class rooms and laboratories

(ii) For Air conditions in laboratories and class rooms

(iii) For operating office equipment such as computers, printers and photocopiers.

(iv) For pumping of drinking water

The amount of the electricity bill was climbing steadily across the years. This audit was undertaken in order to verify how effective these steps were, and also to identify loop holes, if any, in the existing practices, along with outlining measures for enhancing energy utilization.

2. OBJECTIVES

The primary objective of any energy audit is determining ways to reduce energy consumption per unit of product output or to lower operating costs. The recommendations of the study will become a basis for future schemes of better energy consumption and preservation throughout the organization. Specific objectives of the study are:

- Conduct a simple Walk-Through audit or observation of the energy consumption of Electrical appliances within the College buildings
- Verify the steps adopted for energy management in the campus
- Spot the inefficient or inadequate practices, if any
- Improve the energy preserving measures and methods
- Identify potential energy saving opportunities
- Formulate feasible steps and measures to be adopted in the campus

3. METHODOLOGY

Energy audits are primarily classified into

- Preliminary Audit
- Detailed Audit

A Preliminary Audit uses existing data to look extensively at the existing energy consumption patterns and identifies the areas for improvement, sets “reference points”, and identifies areas for more in-depth study.

A Detailed Audit is more comprehensive and is carried out in phases, evaluating all major energy using systems. It estimates energy savings and cost, and accounts for the energy use of all major equipment. Since the Detailed Audit is meant for industry, and because of the limited size and the amount of energy consumption of the institution, the Preliminary Audit method was chosen.

4. DATA COLLECTION

For the purpose of this audit, audit groups for specific areas were formed. Data was collected through

- Visual inspection and observation
- Verification/ Identification of energy consumption
- Detailed calculations, analyses
- Validation

An Energy Audit group was formed in October 2020 with Dr. N.Sambasiva Rao Professor and HOD of EEE.Inspection and data collection were carried out with the help of one member from each department. The final report submitted to the Principal in May 2021.

5. DATA ANALYSIS

The gathered data was then quantified and segregated according to the following criteria:

(1) Block-wise average energy usage

(2) Energy consumption by end use

(3) Consumption equipment-wise and

(4) Rate of consumption month-wise.

The quantified data are presented below as figures and tables for easy reference. The consumption of energy block-wise is shown in Table 1.

The number of different electrical appliances in each block is given in Table 2. The energy consumption by end use is shown in figure 1.

Table 1 Average use of energy block-wise

Block-wise average energy usage

Sl.No.	Block	Average Monthly Consumption (kWh)
1	**Block: I** (i) Administrative Office (ii) Electronics & Communication Engineering (iii) Computer Science and Engineering (iv) Master of Business Administration (v) Library	75120
2	**Block: II** (i) Freshmen Engineering Department (ii) Electrical and Electronics Engineering (iii) Canteen	18768
3	**Block: III** (i) Civil Engineering Department (ii) Information Technology Department	7188
4	**Block: IV** (i) Mechanical Engineering Department	4191
5	**Block: V** (i) Laboratories of Mechanical Engineering & Information Technology Departments	21312
6	(i) Security Office at the Entrance (ii) Temple in the Campus (iii) Food Court (iv) Street lights in Campus	48
7	Fitness Center	120

Table 2. Block-wise Number of different electrical appliances

BLOCK	**Flourescent Tube lights**	***CC Cameras***	**Fans**	**Air Conditioners**	**LED Projectors**	**LED Tube lights**	**Biometric devices**	**Street lights**	**Computers**	**Laptops**	**Printer cum scanners**	**Photocopier**	**Refrigeraotor**	***Electric Ovens***	**Water Coolers**	**Loud Speaker/ Bell**	**Grinder**	**Exhaust fan**
Block: I (CSE,ECE,**MBA**)	122	25	358	76	18	289	1	0	517	28	23	4	0	0	3	2	0	4
Block: II (FED & EEE)	98	10	196	26	12	148	1	0	5	0	2	0	1	2	3	1	1	4
Block: III	32	44	250	0	9	217	1	0	3	0	1	0	0	0	4	2	0	4
Block: IV	4	41	106	2	6	133	0	0	1	0	1	0	0	0	1	0	0	4
Block: V	24	7	133	5	1	80	0	0	280	0	0	0	0	0	0	0	0	0
Security Office	1	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Temple in the Campus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
Food Court	1	0	0	0	0	0	0	0	0	0	0	0	6	0	1	0	4	1
Street lights in Campus	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0
Fitness Center	0	1	4	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
ATM	0	0	0	1	0	2	0	0	1	0	0	0	0	0	0	0	0	.0

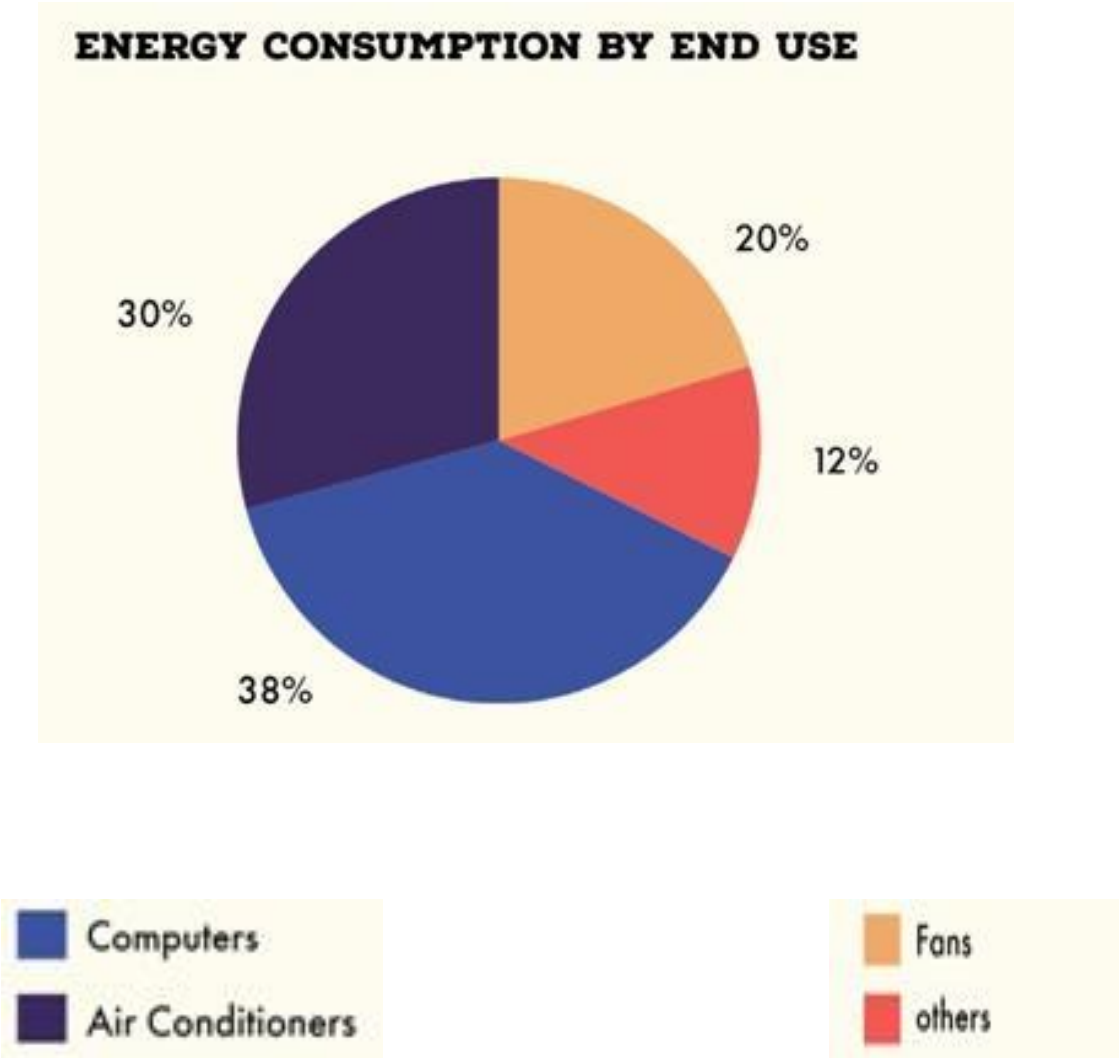


Fig.1. Energy consumption by end use

6. MAJOR FINDINGS

Since this was a Preliminary Audit, the findings are formulated as per the norms for this stipulated by the Energy Audit Manual of the Government of Andhra Pradesh.

I. Establish energy consumption in the organization

From the quantitative analysis of the gathered data, the following findings have been reached.

i. The Computers record the highest consumption based on end use (38%)

ii. The CSE,ECE and MBA Block-1 records the highest rate of consumption

iii. Air Conditioning equipment show the highest rate of consumption equipment-wise

II. Identify the easiest areas of attention

Based on the physical observation and the analysis of data collected, certain areas have been identified as areas of attention.

i. Old wiring cables in many parts of the campus leading to loss of energy

ii. Old water pipelines in several parts of the campus leading to waste of energy

iii. Majority of electricity supply is depending on State Electricity Board, instead of solar panels except two panels in Block-1 & Block-2.

iv. Certain classrooms are under-illuminated, certain classes have more lights than required

III. Estimate the Scope for Saving

Most of the office equipment in all the departments are usually left without turning them off and are using electricity as Vampire loads. Electronics appliances (computer, printer, etc.) are still ON when connected to power point even though they are turned off.

The study could identify a large scope for saving energy in the campus, including updating of technologies in laboratory equipment, replacing old electrical cables and pipelines, replacing lights with LEDs, ensuring even lighting facilities in rooms, use of Solar panels as a main source of lighting, especially common areas and replacing old gadgets in laboratories

IV. Identify immediate areas of improvement

Based on the study, certain areas were identified as requiring immediate improvement. These are

(a) Encouraging students and staff to switch off electrical gadgets and turn off the water taps when not in use

(b) Replacing lights bulbs and tubes with LEDs

(c) Repairing and updating laboratory equipment

V. Identify areas of more detailed study

The study could also identify certain areas that necessitated more detailed study and long-term planning. These were

(i) Planning the electrical wiring more efficiently

(ii) Installing solar panels in some more possible buildings/ blocks

7. SUMMARY OF RECOMMENDATIONS

Based on the general observations carried out throughout the College buildings some recommendations are listed below. The list is in a prioritized order, such that the most urgent where immediate actions are needed to be executed are listed first.

(i) Apply energy conservation measures. Isolate or unplug leech loads from power when not in use (i.e. rechargeable equipment, computer and any other electronic devices with standby modes).

(ii) Remove faulty light holders and bulbs or remove live wire from socket inside the light holder.

(iii) Remove any faulty appliances located in the building.

(iv) Isolate or unplug faulty air conditioners and service the air conditioner units yearly.

(v) Establish Energy Efficiency and Conservation steering committee to take lead with energy efficiency initiatives and management within the buildings

(vi) Renovate or improve the lighting control, i.e. add more switches to existing rooms/spaces where only one switch controls more than 10 lights, especially the lights in large meeting rooms

(vii) Use air conditioners only if the room is very well sealed (i.e. if the room has no seals on the door and frequently open at times do not use A/C)

(viii) Remove lights or reduce the number of lights per location

(ix) Replace all lights with energy efficient LED light bulbs, which is expected to get 50% lighting power savings. Replace 40 W fluorescent tube lights with 20W LED tube lights. Lighting for corridors is can be replaced by 3 W or 7 W LED lamps.

(x) Replace old existing outdoor air conditioner units with energy efficient ones

(xi) Use more solar panels under different schemes of the Government of Andhra Pradesh

8. CONCLUSION

Based on the energy audit carried out in the College, we have identified a few areas to be improved for efficient energy utilization. A well-prepared electrical wiring plan for the campus, which would help identify unused points of power and also in re-wiring the buildings. Electric fans should be serviced and bearings replaced wherever necessary. The scope for non-conventional energy should be utilized. Even though the heritage nature of buildings and Government restrictions may not help in wide installation of roof top solar panels, certain locations like the top of all buildings can be used for installing solar panels which would cut down power consumption. Installation of a suitable Bio-gas plant is to be done to save energy.

. Rigorous training is needed for both students and staff to inculcate awareness for the need of energy conservation. If everyone ensures switching off lights, fans and electrical gadgets that are not in use energy can be saved considerably. A master switch located at a prominent place which can be directly supervised by the HOD would help avoid power wastage in closed rooms. A healthy competition may be encouraged between departments by honoring those departments that produce higher savings by good practices. It is suggested that a permanent body under the chairmanship of a senior professor may be established in the College for periodical review of energy usage and concurrent energy audit. Representatives of students, staff and PTA may be included in the body.

9. BIBLIOGRAPHY

1. Energyaudit of IIT Bombay Campus Technical Report · June 2008

   DOI: 10.13140/RG.2.1.2406.8962

2. Energy Audit Manual from Energy Management Centre. AP Department of Power,

   Government of Andhra Pradesh.

3. New & Renewable Energy Development Corporation of Andhra Pradesh Ltd.(A State Govt. Company)(Formerly Non-Conventional Energy Development Corporation of Andhra Pradesh Ltd.,) manuals
4. References from https://nredcap.in/Downloads.aspx